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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte NAN JIANG, SAMUEL KIM, and ZVI YANIV

Appeal 2016-000429
Application 13/113,264
Technology Center 1700

Before KAREN M. HASTINGS, DONNA M. PRAISS, and
BRIAN D. RANGE, *Administrative Patent Judges*.

PRAISS, *Administrative Patent Judge*.

DECISION ON APPEAL¹

This is an appeal under 35 U.S.C. § 134(a) from the final rejection of claims 1, 3, 5–14, and 16–27. We have jurisdiction under 35 U.S.C. § 6(b).

The subject matter of this appeal relates to designing thermal sinks to transfer heat from a hot spot and diffuse it to a heat sink. Spec. 1. More particularly, the subject matter relates to pressure casting manufacturing methods in which “graphitic needle cokes are utilized, though other graphitic particles may be substituted, including, but not limited to, carbon

¹ This decision makes reference to the Specification filed May 23, 2011 (“Spec.”), the Final Office Action mailed Jan. 5, 2015 (“Final Act.”), the Appeal Brief filed May 14, 2015 (“App. Br.”), the Examiner’s Answer mailed Sept. 10, 2015 (“Ans.”), and the Reply Brief filed Oct. 9, 2015 (“Reply Br.”).

nanotubes.” *Id.* at 4. Claims 1, 7, 17, and 21 are illustrative (disputed elements italicized):

1. A method for making a carbon-aluminum composite comprising:

preparing a mixture of graphitic particles and aluminum by mixing the graphitic particles with aluminum particles; and

pressing the mixture of graphitic particles and aluminum in a heated pressure mold, *wherein the graphitic particles comprise graphitic needle cokes.*

7. A method for making a carbon-aluminum composite comprising:

preparing a mixture of graphitic particles and aluminum by *coating the graphitic particles with aluminum*; and

pressing the mixture of graphitic particles and aluminum in a heated pressure mold, *wherein the graphitic particles comprise graphitic needle cokes.*

17. A method for making a carbon-aluminum composite comprising:

pressing a mixture of graphitic particles and aluminum in a heated pressure mold; and

inserting a ceramic sheet into the mixture before pressing in the heated pressure mold.

21. The method as recited in claim 1, wherein *at least some of the aluminum particles have an anisotropic shape*, and wherein at least some of *the graphitic needle coke particles have an anisotropic shape.*

The Examiner maintains and Appellants² appeal the following rejections:

1. Claim 21 under 35 U.S.C. § 112, first paragraph, for failing to comply with the written description requirement;
 2. Claims 1, 3, 5–7, 10–14, 16, 21, and 25–27³ under 35 U.S.C. § 103(a) over Adams '995⁴ in view of Takeda;⁵
 3. Claim 8 under 35 U.S.C. § 103(a) over Adams '995 in view of Takeda and Rockenberger;⁶
 4. Claim 9 under 35 U.S.C. § 103(a) over Adams '995 in view of Takeda and Withers;⁷
 5. Claims 17–19 under 35 U.S.C. § 103(a) over Adams '995 in view of Adams '851;⁸ and
 6. Claim 20 under 35 U.S.C. § 103(a) over Adams '995 in view of Adams '851 and Takeda.
- App. Br. 8; Ans. 2–7.

² Appellants identify the real party in interest as Applied Nanotech Holdings, Inc. App. Br. 1.

³ Although Appellants and the Examiner omit claim 27 from the list of claims subject to this rejection (Final. Act. 3; App. Br. 8), both Appellants and the Examiner address claim 27 as being subject to the rejection (Final Act. 4; App. Br. 16). Therefore, the rejection of claim 27 is included in this appeal.

⁴ Adams et al., US 2010/0189995 A1 (pub. July 29, 2010) (“Adams '995”).

⁵ Takeda et al., US 2010/0009193 A1 (pub. Jan. 14, 2010) (“Takeda”).

⁶ Rockenberger et al., US 2010/0022078 A1 (pub. Jan. 28, 2010) (“Rockenberger”).

⁷ Withers et al., US 6,723,279 B1 (iss. Apr. 20, 2004) (“Withers”).

⁸ Adams et al., US 6,895,851 B1 (iss. May 24, 2005) (“Adams '851”).

ANALYSIS

The dispositive issues on appeal are:

1. Did the Examiner reversibly err in finding that the term “anisotropic shape” is new matter to the application?
2. Did the Examiner reversibly err in finding that additional admixtures to the aluminum and carbon nanotubes (CNT) disclosed in Adams '995 encompasses graphite suitable for the production of metal-carbon composites and that Takeda informs one of ordinary skill in the art that graphitic needle coke is a source or type of graphite suitable for the production of aluminum-based composite materials?
3. Did the Examiner reversibly err in finding that the milled particles of Adams '995 and Takeda display anisotropic shape or morphology?
4. Did the Examiner reversibly err in finding that graphite is capable of being coated with molten metal by (1) dipping and (2) sputter coating methods in view of Rockenberger and Withers, respectively, in combination with Adams '995 and Takeda?
5. Did the Examiner reversibly err in finding that a skilled artisan would have increased the overall strength of the composite of Adams '995 by adding a ceramic sheet in view of the disclosure in Adams '851 of ceramic sheets to reinforce a metal composite?

After review of the arguments and evidence presented by both Appellants and the Examiner, we reverse the written description rejection under Section 112, first paragraph, and affirm the obviousness rejections under Section 103(a). A preponderance of the evidence, as referenced in the

Final Office Action and the Answer, supports the Examiner's findings and conclusions regarding obviousness, and we provide additional discussion for emphasis below.

Rejection 1: Written Description

It is the Examiner's position that claim 21, which recites "anisotropic shape," is not supported by the disclosure in the Specification of "anisotropic behavior" for the reasons stated on page 2 of the Answer and pages 2–3 of the Final Action.

In the Appeal Brief, Appellants contend that the reference to anisotropic behavior on page 4 of the Specification describes the mechanical shaking of the mixture and refers to the shape of aluminum particles and graphitic needle cokes. App. Br. 9 (also citing Figure 8 for images of needle cokes having an anisotropic shape). Appellants further argue that uniform mixing of the materials "exploit[s] the fact that many of the graphitic needle coke particles have an anisotropic shape" and that "the language within Claim 21 is clear and understandable" to a skilled artisan from the Specification as well as "what is well-known about the structures of graphitic needle cokes." *Id.*

The Examiner responds that a skilled artisan "would associate the term 'anisotropic' with behavior" as demonstrated by the disclosure of anisotropy in paragraphs 51 and 52 of Adams '995. Ans. 8.

In the Reply Brief, Appellants contend that the discussion of anisotropy in paragraphs 51 and 52 of Adams '995 "is referring to the structure and mechanical and physical properties[, which] do not have a 'behavior.'" Reply Br. 2–3. Appellants also contend that Adams '995 "is

referring to how such structures and mechanical and physical properties are physically aligned in the semi-finished products and molded bodies.” *Id.* at 3. Appellants further contend that the disclosure on page 5 of the Specification of “the anisotropic particles of aluminum and graphitic needle cokes” being mixed during the shaking step provides further written description support for claim 21. *Id.* at 2.

We agree with Appellants that the context in which the Specification uses the term anisotropic is directed to a physical characteristic of the particles that affects mixing, including particle size and shape. Page 4 of the Specification refers to the anisotropic property of the graphitic needle cokes in particular impacting the performance of “mechanical shaking of the C/Al mixture.” Spec. 4. Page 5 describes “particles of aluminum and graphitic needle cokes” being mixed during the shaking step as “anisotropic” and, the effect being “uniformity and directionality of the mixture.” *Id.* at 5. The Specification further discloses that “[a] more uniform mixture can be obtained by selecting a mixture of different-sized graphitic needle cokes to form a dense topology compact” and refers to Figure 8 as showing “different sizes and shape of graphitic needle cokes.” *Id.* at 4. Such physical characteristics of the particles being described as anisotropic is consistent with the use of the term in Adams ’995, which describes “anisotropy” as being present “in the structure and mechanical and physical properties” of materials. Adams ’995 ¶ 51; *see id.* ¶ 52 (referring to “controlled anisotropy of the material properties such as the tensile strength.”).

In sum, the preponderance of the evidence in this record demonstrates that “anisotropic shape” recited in claim 21 has written description support

in pages 4 and 5 and Figure 8 of the Specification. Therefore, we reverse the rejection of claim 21 under 35 U.S.C. § 112, first paragraph.

Rejection 2: Adams '995 and Takeda

It is the Examiner's position that Adams '995 and Takeda suggest the subject matter of claims 1, 3, 5–7, 10–14, 16, 21, 25–27 for the reasons stated on pages 2–4 of the Answer and pages 3–5 of the Final Action.

In the Appeal Brief, Appellants do not provide separate substantive arguments for claims 1, 7, and 12, but rely upon the same arguments presented with respect to claim 1. App. Br. 14. Appellants rely on the same arguments presented with respect to claim 11 to show the patentability of claim 14. *Id.* Appellants do not argue claims 5, 6, and 26. *Id.* at 9–16. Therefore, we select claim 1 as representative of claims 1, 5–7, and 12, and claim 11 as representative of claims 11 and 14. Claims 5–7 and 12 stand or fall with claim 1, claim 14 stands or falls with claim 11, and claim 26 stands or falls with claim 25. *See* 37 C.F.R. § 41.37(c)(1)(iv).

Regarding claim 1, Appellants contend that because “Takeda does not suggest mixing graphitic needle coke particles with aluminum particles and then pressure molding that mixture[,]” there is no teaching or suggestion in either Adams '995 or Takeda of “the claimed method of mixing graphitic needle coke particles with aluminum particles for a subsequent pressure molding.” App. Br. 10. Appellants further argue that “there is no suggestion in Takeda to substitute graphitic needle coke particles for the CNTs in Adams '995.” *Id.* at 11. Based on these asserted deficiencies of Takeda, Appellants argue that the combination of Takeda and Adams '995 does not disclose the method of claim 1 and “[t]he only suggestion to veer

from the prior art process of impregnation of molten aluminum into a graphite material is provided by Appellants' disclosure and claims." *Id.* Appellants contend the language in paragraphs 46 and 59 of Adams '995 "merely suggests to one of ordinary skill in the art to utilize CNTs." *Id.* According to Appellants, "Adams '995 is only enabling for utilizing CNTs" (*id.* at 12), the combination of references "would not suggest that a deviation from this prior art process is possible by substituting the graphitic needle coke particles of Takeda for the CNTs of Adams '995 without having to resort to undue experimentation" (*id.* at 11), and Appellants' distinctions over the references separately shows "how a reference teaches away from the claimed invention" (*id.* at 12). Appellants also assert that Takeda does not disclose that graphite imparts high thermal conductivity to articles as the Examiner finds, but, rather that "the graphite material as finally produced in Takeda would have a high thermal conductivity." *Id.* at 13. These arguments are addressed following the summary of Appellants' arguments.

Regarding claims 3 and 25, Appellants recite the claims and state, without elaboration, that the Examiner has not addressed the recitation. App. Br. 13, 15. This kind of presentation is insufficient to establish Examiner error. *In re Lovin*, 652 F.3d 1349, 1357 (Fed. Cir. 2011) (holding that merely asserting that applied prior art does not teach a recited limitation is not substantive argument for separate patentability); *see also* Ans. 3 (addressing claim 3 and providing citations to Adams '995), 12 (addressing the "consisting of" limitation in claim 25 and explaining that "there are no other steps in Adams '995 that are required to carry out the basic method of pressure molding").

Regarding claim 10, Appellants argue that the references teach away from pressure molding graphitic and aluminum processes by leading one of ordinary skill to utilize impregnation of molten aluminum into a graphitic material. App. Br. 14. This argument substantively overlaps with the argument provided for claim 1 and is also addressed below.

Regarding claim 11, which recites “a temperature of the heated pressure mold is 660°C or greater,” Appellants contend that there would be no expectation of success from the combination of references because “the combination of the references teaches away from their combination since the temperature disclosed for performing a pressure molding process in Adams ’995 is disparate and contradictory to the much higher temperature of 1000°C taught in Takeda.” *Id.* Appellants also assert that undue experimentation would be required to determine which temperature range would be successful and cannot be assumed by the Examiner. *Id.* These arguments are also addressed below.

Regarding claim 16, the claim recites “adding silicon powders to the mixture before pressing in the heated pressure mold.” App. Br. 21 (Claims App’x). Appellants argue that Adams ’995 does not teach this recitation, but Appellants fail to argue that the recitation is not taught by the combination of Adams ’995 and Takeda as asserted by the Examiner. *Id.* at 15. As such, this argument fails to establish error. “Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references.” *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986).

Regarding claim 21, which requires that at least some of the aluminum particles and the graphitic needle coke particles have an

anisotropic shape, Appellants argue that Adams '995's disclosure that the composites may be anisotropic "does not specifically address the claimed invention" because "finished products and bodies having an anisotropy structure is not the same as the recited aluminum and graphitic needle coke particles each having anisotropic shapes." App. Br. 15. This argument is addressed below.

Regarding claim 27, Appellants argue that the references do not lead to substitution of graphitic needle cokes for the CNTs disclosed by Adams '995. *Id.* at 16. This argument substantively overlaps with the argument provided for claim 1 and is also addressed below.

The Examiner responds to Appellants' arguments above by finding that "Takeda's teaching of impregnation methods does not teach away from the pressure molding method disclosed by Adams '995" and Adams '995 itself acknowledges that impregnation (or infiltration) is "another way of incorporating aluminum into graphite-based compacts containing graphite powders." Ans. 9. The Examiner finds that paragraph 42 of Adams '995 "teaches that the incorporation of other carbon-based powders into the aluminum-CNT mixture is expected to be carried out successfully" and that Takeda shows graphitic needle coke powder can be successfully pressure molded to create a composite material with a metal-containing powder. *Id.* at 10 (citing Takeda ¶¶ 14–16, 52–55). The Examiner cites paragraph 26 of Takeda for disclosing that thermal conductivity originates from the graphite component of the composite. *Id.* Regarding the claimed temperature, the Examiner also finds that Adams '995 teaches that the melting temperature of metal is referred to, thus, "it is implicit that the process is conducted at a temperature sufficient to melt the metal, i.e., 750°C or higher, and this

would not conflict with Takeda's temperature of 1000°C." *Id.* at 11.

Regarding the claimed anisotropic shape, the Examiner finds that both Adams '995's aluminum and Takeda's graphitic needle coke powder are milled and therefore "not unlike those shown in Fig. 8." *Id.* at 12.

In the Reply Brief, Appellants further argue that "Adams '995 merely suggests graphite, but does not specifically identify graphitic needle coke." Reply Br. 3. Regarding Takeda's disclosure of thermal conductivity being contributed to the graphite material, Appellants' assert that Takeda teaches "a conventional graphite material heated to a very high temperature allows the graphite material to exhibit properties such as thermal conductivity peculiar to the graphite material." *Id.* at 4. Regarding the temperature range disclosed by Adams '995, Appellants contend the temperature is "less than 750°C, because the process must be able to melt the metal and not the powdery matrix material (i.e., the CNT-containing material)." *Id.* Regarding anisotropic shape, Appellants contend that Adams '995 merely discloses the use of the metal in a grainy manner or in granular or powder form" which Appellants argue "is not the same as disclosing aluminum particles with an anisotropic shape." *Id.* at 5.

We are not persuaded that the Examiner erred in finding that Adams '995 discloses (1) a composite containing aluminum and carbon nanotubes (graphitic particles), (2) that additional admixtures such as graphite may be contained therein, and (3) that the composite is formed by applying pressure in a heated casting mold. We also are not persuaded that the Examiner erred in finding that needle coke powder is a starting material used in the manufacture of metal-graphite composites, as evidenced by Takeda, and that it would have been obvious to one of ordinary skill in the art to combine

needle coke powder, as a form of graphite, in admixture with the composite materials of Adams '995 in view of the explicit teaching in Adams '995 that such material may contain functional admixtures of graphite. In addition, we are not persuaded that the Examiner erred in finding that Adams '995 discloses a temperature range that overlaps the range required by claim 11 for the temperature of the heated pressure mold and that the milled aluminum particles of Adams '995 encompass the claim 21 requirement that “at least some of the aluminum particles have an anisotropic shape.” A preponderance of the evidence (as cited by the Examiner) supports these findings.

Appellants' arguments are not persuasive because there is no *ipsissimis verbis* test for determining whether a reference discloses a claim element, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 832 (Fed. Cir. 1990). Appellants may be correct that Adams '995 does not specify graphitic needle coke particles by that name as an example of functional admixtures in paragraph 42, however, Appellants do not direct us to any evidence that Adams '995's disclosure of graphite for the functional admixture would not encompass graphitic needle coke particles.

Nor do Appellants direct us to any evidence that one of ordinary skill in the art would understand Adams '995's disclosure of graphite for its admixture to be limited in any manner that would exclude needle coke. Instead, Appellants argue that “Adams '995 does not suggest needle coke powders [specifically] can be substituted for its CNTs.” App. Br. 13. A preponderance of the evidence, however, supports the Examiner's finding “that graphitic needle coke is a type suitable for the production of aluminum-based composite materials” (Ans. 9), and Appellants do not

persuasively dispute this point. Thus, the evidence supports that a person of skill in the art would understand Adams '995's disclosure of graphite as also disclosing use of needle coke particles.

Similarly, Appellants do not dispute that both Adams '995 and Takeda disclose that their carbon component imparts thermal conductivity and that the addition of graphite needle coke to Adams '995's mixture of aluminum and carbon nanotubes improves thermal conductivity. Instead, Appellants assert that "Takeda are not merely disclosing that graphite imparts high thermal conductivity in articles." App. Br. 13. In a determination of obviousness, a reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art. *Merck & Co. v. Biocraft Labs.*, 874 F.2d 804, 807 (Fed. Cir. 1989) ("That the [prior art] patent discloses a multitude of effective combinations does not render any particular formulation less obvious."); *In re Mills*, 470 F.2d 649, 651 (CCPA 1972) (citation omitted) ("a reference is not limited to the disclosure of specific working examples."). Appellants' arguments limiting the disclosures in both Adams '995 and Takeda to particular embodiments rather than addressing the broader disclosures as would have been understood by one of ordinary skill in the art are not insightful and, consequently, are unpersuasive.

Appellants' argument that Adams '995 and Takeda teach away from each other because they disclose different methods and temperatures for making carbon and metal composites is not persuasive. A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was

taken by the applicant. *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994). As the Examiner finds, and Appellants do not dispute, Takeda's impregnation method is a method acknowledged in Adams '995. Ans. 9. Because the methods of Adams '995 and Takeda are alternative methods for producing carbon-metal composites, and specifically carbon-aluminum composites as described in Adams '995, this suggests the admixture examples taught by Adams '995 encompasses known graphite suitable for the production of metal-carbon composites. *See id.* Appellants do not direct us to any evidence that Takeda teaches away from graphitic needle coke being a source of graphite such that it can be used as a functional admixture as suggested by Adams '995. Moreover, in addition to Adams '995 explicitly describing temperature in terms of the melting temperature of the metal as guidance to one of ordinary skill in the art, the temperature ranges disclosed in both Adams '995 and Takeda overlap the temperature range recited in claim 11. Therefore, we are not persuaded by Appellants' argument that the temperature used in Takeda's process teaches away from the temperature used in the Adams '995 process or the temperature required by claim 11.

Regarding the requirement in claim 21 for both the aluminum particles and the graphitic needle coke particles to have at least some of the particles have an anisotropic shape, Appellants do not dispute that many graphitic needle coke particles have an anisotropic shape. App. Br. 9, 15. Regarding the disclosure of milled aluminum particles in Adams '995, Appellants' contention that "is not the same as disclosing aluminum particles with an anisotropic shape" (Reply Br. 5) does not rebut the Examiner's finding that "milling produces rough, granular particles not unlike those shown in Fig. 8 [of Appellants' Specification]" (Ans. 12). As

discussed above, determining whether a reference discloses a claim element is not an *ipsissimis verbis* test. *In re Bond*, 910 F.2d at 832. Similarly, Appellants' argument that Figure 4 of Adams '995 discloses the final product rather than the starting materials (Reply Br. 5) also is insufficient to rebut the Examiner's findings, because (1) claim 21 does not have a temporal limitation, (2) even if claim 21 requires the presence of an anisotropic shape in the starting materials, Appellants do not direct us to any evidence that such anisotropic shape results from applying pressure in a heated casting mold rather than from milling, (3) Appellants do not dispute the Examiner's finding that the recited "anisotropic shape" is disclosed in Figure 4 of Adams '995, (4) Appellants do not dispute the Examiner's finding that the recited "anisotropic shape" is disclosed in Figures 5–9 as well of Adams '995 (Ans. 12), and (5) Figures 5–9 of Adams '995 "show the starting products and finished material components seen through a microscope" (Adams '995 ¶ 67).

In sum, we are not persuaded that the Examiner erred in rejecting claims 1, 3, 5–7, 10–14, 16, 21, and 25–27 under 35 U.S.C. § 103(a) over Adams '995 and Takeda.

Rejection 3: Adams '995, Takeda, and Rockenberger

It is the Examiner's position that Adams '995, Takeda, and Rockenberger suggest the subject matter of claim 8 for the reasons stated on pages 4–5 of the Answer and pages 5–6 of the Final Action.

In the Appeal Brief, Appellants argue that "Rockenberger does not in any way teach or suggest dipping a substrate in aluminum ink." App. Br. 16. Appellants also argue that the Examiner's reason for combining

Rockenberger with the method of Adams '995 as modified by Takeda is not supported by objective evidence and one of ordinary skill in the art would not have an expectation of success because “a process of dipping micron-sized graphitic particles into an aluminum ink is not nearly as easy as using a printing process to print an aluminum ink film onto a relatively large substrate.” *Id.* at 16–17.

The Examiner responds that “graphitic needle cokes would be coated with aluminum when aluminum ink is deposited on them” and “[t]he formation of coating implies that the graphite has been dipped into molten aluminum.” Ans. 12. The Examiner finds that “the pressing temperatures in Adams '995 is sufficient to keep the aluminum metal molten (paragraph [0054]); therefore, the presence of graphite in molten aluminum metal is graphite dipped in metal.” *Id.* at 13. Regarding expectation of success, the Examiner finds that Rockenberger evidences dip coating and that “small particles can be dispersed in aluminum ink solution.” *Id.* at 12–13.

In the Reply Brief, Appellants further argue that Adams '995 discloses “infiltrating molten metal into the CNT-containing material” and does not suggest “dipping the CNTs in molten aluminum and then thermal curing the aluminum-coated CNTs before then pressing the mixture into a heated pressure mold.” Reply Br. 7. Appellants assert that the Examiner erred by “parsing the various limitations and not considering the claimed invention as a whole.” *Id.*

We are not persuaded that the Examiner erred in finding that Adams '995's disclosure of carbon particles being immersed in molten aluminum teaches or suggests “dipping the graphitic needle cokes into an aluminum ink” as recited by claim 8. Under a broadest reasonable interpretation,

dipping into an aluminum ink includes infiltrating or immersing in an aluminum ink. Appellants do not provide any basis for a more narrow interpretation, and we do not discern a basis for a more narrow interpretation from the Specification. *See* Spec. 5 (referring to “dipping the graphitic needle cokes into aluminum inks” without further elaborating on what is meant by “dipping”).

Appellants’ argument that the Examiner erred by “parsing” the claim limitations is not persuasive because, although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

Appellants’ argument that the Examiner’s rejection lacks a reasonable expectation of success is not persuasive because Appellants do not dispute that Rockenberger evidences that aluminum can be manufactured into an ink that is applied to a substrate or suspending nanoparticles. Ans. 13.

Moreover, both the Specification and Rockenberger evidence that “inking” and “dipping” are known methods of coating that do not require a more detailed explanation to one of ordinary skill in the art. Spec. 5 (“Such coating processes may be, but are not limited to, inking, plating, and sputtering methods. For example, the aluminum coatings may be applied by . . . (1) dipping . . .”); Rockenberger ¶ 19 (“In the present application, the term ‘deposit’ . . . is intended to encompass all forms of deposition, including . . . dip coating . . .”); *see In re O’Farrell*, 853 F.2d 894, 903–04 (Fed. Cir. 1988) (“Obviousness does not require absolute predictability of success. . . . [A]ll that is required is a reasonable expectation of success.”). Accordingly, we are not persuaded that the Examiner erred in finding claim

8 unpatentable under 35 U.S.C. § 103(a) over Adams '995, Takeda, and Rockenberger.

Rejection 4: Adams '995, Takeda, and Withers

It is the Examiner's position that Adams '995, Takeda, and Withers suggest the subject matter of claim 9 for the reasons stated on page 5 of the Answer and page 6 of the Final Action.

In the Appeal Brief, Appellants argue that the Examiner erred in not addressing "all of the limitations recited within Claim 9" because "[t]here are no graphitic fibers recited within Claim 9. Instead, graphitic needle coke particles are coated with such a sputtering process." App. Br. 17.

Appellants also argue that Withers' disclosure of coating graphite fibers using a sputter coater does not "correspond to micron-sized graphitic particles." *Id.* at 17–18. According to Appellants, the Examiner's combination of Withers with Adams '995 and Takeda "would require undue experimentation" in order to combine the sputtering process disclosed in Withers with the graphitic needle coke particles recited in claim 9. *Id.* at 18.

In response, the Examiner finds that "Withers does not limit the size of the particles being coated" and that "graphite fibers, such as CNTs, may have dimensions as high as up to 0.5 mm (up to 500 μ m) (Adams '995, paragraphs [0040], [0041]) . . . not unlike the graphitic needle coke particles of Takeda that are 100 μ m in size (paragraph [0053])." Ans. 14.

Appellants do not dispute the Examiner's finding that the size of Withers' graphite fibers is not unlike the size of Takeda's graphitic needle coke particles in the Reply brief.

We are not persuaded that the Examiner erred in finding that “it would have been obvious to one of ordinary skill in the art to have sputter coated the needle cokes of Adams and Takeda in order to achieve a desired aluminum thickness on the fibers” as taught by Withers. Final Act. 6 (citing Withers 14:27–31, 25:55–56). The Examiner’s reason for combining Withers with Adams ’995 and Takeda to achieve a desired aluminum thickness is supported by the record. The Examiner finds that Takeda teaches the graphitic needle particles recited in the claim, therefore, the Examiner has shown that all of the limitations of claim 9 are disclosed in the cited prior art references. Finally, Appellants do not dispute that the size of graphite fibers such as CNTs is not unlike Takeda’s graphitic needle coke particles.

In sum, Appellants have failed to identify reversible error in the Examiner’s rejection of claim 9 under 35 U.S.C. § 103(a) over the combination of Adams ’995, Takeda, and Withers.

Rejection 5: Adams ’995 and Adams ’851

It is the Examiner’s position that Adams ’995 and Adams ’851 suggest the subject matter of claims 17–19 and 22–24 for the reasons stated on pages 5–7 of the Answer and pages 6–7 of the Final Action.

In the Appeal Brief, Appellants separately argue the patentability of claims 17 and 18 while grouping them together with claims 19 and 22–24. App. Br. 18–19. Therefore, we select claim 17 as representative and claims 19 and 22–24 will stand or fall together with claim 17. *See* 37 C.F.R. § 41.37(c)(1)(iv).

Regarding claim 17, Appellants contend that the Examiner's rejection is in error for the same reasons argued with respect to claim 1. App. Br. 18. Appellants also argue that

the combination of the references does not teach adding a ceramic plate to a mixture of graphitic and aluminum particles. Instead, the combination of the references clearly teaches to one of ordinary skill in the art to add molten aluminum to a set of layered materials to infiltrate the molten aluminum into these layers and the materials they comprise.

Id.

Regarding claim 18, Appellants contend that "[t]he Examiner has not addressed how the combination of the references would perform such a cutting or slicing process to produce a carbon-aluminum composite with a ceramic surface." *Id.* at 18–19.

The Examiner responds that "Adams '851's teaching of infiltration methods does not teach away from the pressure molding method disclosed by Adams '995" particularly because "Adams '995 acknowledges that impregnation (also referred to as infiltration) is merely another way of incorporating aluminum into graphite-based compacts containing graphite powders (paragraphs [0050], [0053])." Ans. 14. The Examiner also finds that "Adams '851 shows that the hard layer 25 is exposed at a top surface after being pressed in a mold (Fig. 1)" and "[c]utting would allow a person of ordinary skill in the art to obtain a desired shape and/or size required to meet a predetermined specification." *Id.*

In the Reply Brief, Appellants further argue that the combination of Adams '995 and Adams '851 "does not disclose the claimed process, since such a combination would merely suggest to one of ordinary skill in the art to perform a process that is in reverse order relative to the claimed process."

Reply Br. 7. Appellants further argue that the combination of references “would result in an aluminum infiltrated graphite-based compact with no way of then inserting the ceramic structures of Adams ’851.” *Id.* at 8. Appellants argue in addition that the Examiner’s citation of Figure 1 is directed to the initial set up. *Id.*

As an initial matter, we are not persuaded that the Examiner erred in rejecting claims 17 and 18 for the same reasons discussed above in connection with claim 1. We also are not persuaded that the Examiner erred in finding that “it would have been obvious to one of ordinary skill in the art to have added ceramic sheets of Adams ’851 to the molded mixture of Adams ’995 because the plates would further reinforce the molded product, thereby increasing its overall strength.” Final Act. 7. The Examiner’s reason for combining the ceramic sheet of Adams ’851, required by claim 17, is supported by the evidence. Adams ’851, 2:1–18. The Examiner’s reason for cutting the carbon-aluminum composite to produce a plate with a ceramic surface as required by claim 18, namely, to obtain a desired shape or size, is reasonable and not disputed. Moreover, Adams ’851 discloses shape as a design consideration for composites with reinforcing sheets. *Id.* at 3:10–15.

Appellants’ additional arguments are not persuasive because Adams ’851 discloses ceramic plates for reinforcing a metal-carbon composite. As discussed earlier, a reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art. *Merck & Co.*, 874 F.2d at 807. Also, as discussed above in connection with claim 1, the fact that a prior art reference discloses an impregnation or infiltration method for producing a metal-carbon composite does not alone teach away

from combination with the teachings of Adams '995. In order to be said to teach away, the reference would have to discourage a skilled artisan from following the path set out in the reference, or lead the skilled artisan in a direction divergent from the path that was taken by the applicant. *In re Gurley*, 27 F.3d at 553. As the Examiner finds, and Appellants do not dispute, the impregnation method is a method acknowledged in Adams '995. Ans. 14. Because the methods of Adams '995 and Adams '851 are alternative methods for producing carbon-metal composites, and specifically carbon-aluminum composites as described in Adams '995, this suggests that the additional reinforcement plates taught by Adams '851 would have been an obvious modification for strengthening the molded product of Adams '995.

Appellants' arguments are also unpersuasive to the extent they seek to go beyond the teachings of Adams '851 for reinforcing a composite and bodily incorporate the layers as well as the process of Adams '851 in the process of Adams '995. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) ("if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill."); *In re Sneed*, 710 F.2d 1544, 1550 (Fed. Cir. 1983) ("[I]t is not necessary that the inventions of the references be physically combinable to render obvious the invention under review."); *In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) ("Combining the teachings of references does not involve an ability to combine their specific structures.").

Appellants also assert that the Examiner reversibly erred by not addressing "how the combination of the reference would perform such a

cutting or slicing process” (App. Br. 18–19) as required by claim 18. In response to the Examiner’s finding that “cutting is a means of attaining the final shape and/or size that is desired” (Final Act. 7), Appellants do not direct us to any evidence that this would exceed the level of skill in the art and do not persuasively dispute this finding of fact underlying the Examiner’s conclusion that cutting would have been obvious. Appellants’ assertion of error fails to address how the level of skill in the art impacts the Examiner’s obviousness analysis. Based on the cited prior art references, we are not persuaded that cutting would be beyond the skill of a person having ordinary skill in the art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“[T]he absence of specific findings on the level of skill in the art does not give rise to reversible error ‘where the prior art itself reflects an appropriate level and a need for testimony is not shown’”) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985)).

In sum, Appellants have failed to identify reversible error in the Examiner’s rejection of claims 17 and 18 under 35 U.S.C. § 103(a) over the combination of Adams ’995 and Adams ’851. Accordingly, we affirm the rejection of claims 17–19 and 22–24.

Rejection 6: Adams ’995, Takeda, and Adams ’851

It is the Examiner’s position that Adams ’995, Takeda, and Adams ’851 suggest the subject matter of claim 20 for the reasons stated on page 7 of the Answer and page 8 of the Final Action. Claim 20 depends from claim 18 and further recites “wherein the graphitic particles comprise graphitic needle cokes.” App. Br. 21 (Claims App’x).

In the Appeal Brief, Appellants argue that “Claim 20 is patentable for similar reasons as given above with respect to Claims 17 and 18.” App. Br. 19. Appellants also argue that “Claim 20 is patentable for similar reasons as given above with respect to Claim 1.” *Id.*

Appellants’ arguments are not persuasive for the same reasons discussed above in connection with claims 1, 17, and 18. Accordingly, we affirm the rejection of claim 20.

CONCLUSION

For the foregoing reasons, we reverse the Examiner’s rejection under 35 U.S.C. § 112, first paragraph, and we affirm all of the Examiner’s rejections under 35 U.S.C. § 103(a).

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(v).

AFFIRMED